Dust Monitoring Program
Fisherman Islands

Annual Report for the Period
November 2003 to November 2004

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Prepared for

Port of Brisbane Corporation

ask
CONSULTING ENGINEERS
ABN 95 064 952 030

Corner Wickham Terrace & Leichhardt Street, Spring Hill Q 4000. PO Box 501, Spring Hill Q 4004.
T 07 3831 7511 F 07 3831 7661 E mail@askce.com W www.askce.com

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1 Introduction

ASK Consulting Engineers was commissioned by Port of Brisbane Corporation (PBC) to carry out a 12 month dust monitoring study at Fisherman Islands.

The main aim of the study is to quantify the atmospheric dust impacts onto a parcel of land earmarked for motor vehicle storage, referred to in this report as the subject site.

This report contains the findings for the 12 months of monitoring from November 2003 to November 2004.

2 Subject Site

The subject site is shown in Figure 1. It is located towards the southern side of Fisherman Islands, just to the north of the Visitors' Information Centre, and to the east of the railway line.

3 Sources of Dust

A number of dust sources, associated with export/import activities at the Port are located generally to the west south west, west and north west of the subject site. These are also shown in Figure 1. They are dealt with individually below.

3.1 Queensland Bulk Handling Pty Ltd

Queensland Bulk Handling Pty Ltd (QBH), a coal export facility, is located to the west of the subject site. The nearest distance from the subject site to the QBH site is approximately 320 m.

Coal is transported to the Port by train at the rate of approximately 3 trains per week. A coal transfer point (unloading of trains) is located in relatively close proximity to the subject site near its southwestern corner. The coal is then transferred by covered conveyor belts to the QBH storage site. Dust suppression in the form of water sprays is applied to the stored coal.

3.2 Sunstate Cement

Sunstate Cement is located to the north east of QBH and to the west of the subject site. This cement manufacturing facility receives both clinker and bulk cement via ships on the wharf. The nearest distance from the subject site to Sunstate Cement is approximately 240 m.

3.3 Woodchip Facility

The QCE woodchip facility is located to the north east of Sunstate Cement. At this facility tree trunks are reduced to wood chips, which are stockpiled and then exported.

3.4 Other Sources

Other potential pollutant emitting sources are located further to the northeast and include a grain terminal (located adjacent to the woodchip facility) and container terminals.

There are other minor sources of pollution in the vicinity of the subject site. These include road traffic and diesel trains.

These sources are unlikely to significantly affect the subject site.

Earthworks, which occur from time to time as part of continued development of Fisherman Islands, represent temporary or short-term sources of dust and sand. When such activity occurs in relative proximity to a monitoring site then this source may dominate the material collected.

4 Dust Monitoring Methodology

4.1 Site Selection

Four sites were selected for the purposes of collecting dust samples using the dust deposition gauge method to gain an understanding of airborne pollutants on the subject site. They are denoted as locations 1-4 and are shown in Figure 1.

Locations 1-3 were selected to have a suitable coverage of the subject site along the northwestern boundary (closest to the potential sources of emissions into the atmosphere). Location 4 is to the northwest of the subject site and in relatively close proximity to some of the sources.

Location 1 is situated close to the northern corner of the subject site, at a distance of some 30 m from the railway line.

Location 2 is also located some 30 m from the railway line, opposite the woodchip facility, and southwest of location 1.

Location 3 is near the southern extremity of the site in relatively close proximity to the Visitors' Information Centre.

Location 4 is just to the west of the Seafarer's Centre with the woodchip and cement plants to the south west. This location represents the site proposed for quay line processing of automobiles once unloaded from sea going vessels.

These sites were chosen using the following criteria:

The sites meet all of the criteria contained in AS3580.10.1 entitled *Determination of particulates – Deposited matter – Gravimetric method*, except for the height above ground. In this instance a uniform height above ground of approximately 2.9 m was used, rather than the Standard nominated 2±0.2 m.

The main reason for the increased height was security of the gauges. Three of the gauges were located on top of shipping containers.

4.2 Dust Deposition Gauges

The study was based on obtaining 12 monthly dust deposition gauge samples, both on and off the subject site.

Table 4.1 shows the commencement and finishing dates for each of the sampling periods.

All of the 48 samples were successfully retrieved for analysis.

Table 4.1 Sampling Periods

Period I	Starting date	Finishing date	Sample Identification
1	03/11/03*	02/12/03	November
2	02/12/03	02/01/04	December
3	02/01/04	03/02/04	January
4	03/02/04	05/03/04	February
5	05/03/04	02/04/04	March
6	02/04/04	07/05/04	April
7	07/05/04	07/06/04	May
8	07/06/04	07/07/04	June
9	07/07/04	07/08/04	July
10	07/08/04	07/09/04	August
11	07/09/04	07/10/04	September
12	07/10/04	05/11/04	October

* Starting date location 3 was 18/11/03

4.3 Study outcomes

The required outcomes are to quantify the dust deposition rates of materials of interest, including

(i) insoluble matter,

(ii) (ii) ash,

(iii) (iii) cement,

(iv) (iv) coal,

(v) (v) woodchip dust and

(vi) (vi) grain.

Insoluble matter is defined as material which does not dissolve in water.

The dust deposition rates are expressed in terms of $mg/m^2/day$.

These deposition rates may then be used to determine the average impact of these materials on the suitability of the subject site for motor vehicle storage.

In conjunction with meteorological data collected on site, 12 samples of 1 month for a 1 year period allows seasonal factors to be determined.

5 Dust Analysis Methodology

The dust samples collected have been analysed in the following way.

Once the samples are collected they are stored in a laboratory. The contents are then filtered through a 1mm stainless steel sieve onto pre-weighed membrane filters and dried. The weight of the insoluble matter is then recorded. The deposits on the membrane filters are then examined by means of stereomicroscopy and photos of the deposits taken (photomicrographs).

A small portion of the filter is then excised and subjected to further testing using Polarising Optical Microscopy and Scanning Electron Microscopy with Energy Dispersive X-Ray Analysis. These analyses allow the type of material deposited on the filters to be identified. The amount of each material present is described in terms of "projected area basis". The term "projected area basis" means the approximate percentage of the area a type of material covers. This term does not represent the percentage weight or volume, since the specific gravity of the various materials is not known.

The remaining portion of the filter was ashed and the weight of the ash and combustible matter were recorded.

Finally, the ash was used to determine the cementatious calcium by digesting the ash in hydrochloric acid. The calculations assume that there is 65% calcium oxide in cement and that all calcium dissolved by the hydrochloric acid is cementatious.

6 Meteorological Data

6.1 All Wind Directions

Wind speed in terms of knots and wind direction in terms of degrees are gathered on the subject site by PBC. They are obtained every 10 minutes.

Data recovery from the meteorological station during the 12 month dust monitoring period was 91.7%. Approximately two week's data was lost in March 2004.

For analysis purposes the meteorological data was transformed into wind direction/wind speed tables for each of the dust monitoring periods identified in Table 4.1.

The wind direction data was grouped into 8 sectors each of 45 degrees and centered on N, NE, E, SE, S, SW, W and NW.

The average wind speed data obtained was transformed into units of km/hr.

Figure 2 shows the annual wind statistics in terms of frequency of occurrence by wind direction and wind speed. This figure shows that the main wind directions are SE (18%), N (16%) and SW (15%), while the dominant wind speeds are in the range 11-20 km/hr (40%) and 6-10 km/hr (37%).

Figure 3 shows the frequency of occurrence of wind speed category as a function of wind direction. The average wind speed for the sectors N-SE tend to be significantly higher than winds in other sectors, particularly the SW, where the average wind speed tends to be rather low.

Figure 4 shows the average wind speed as a function of wind direction. This figure indicates that winds with an easterly/northerly component have significantly higher average wind speeds (in the range 11.2-15.0 km/hr) than those with a westerly/southerly component (in the range 6.9 km/hr-9.4 km/hr).

6.2 Winds Causing Pollutants To Be Carried To Subject Site

From Figure 1 it may be noted that the nearby industries are located from the south through to the NW from the site. Any pollution generated by these industries would be carried by winds from the SW through to the N towards the site. Therefore these wind directions are of particular interest and deserve to be looked at in more detail.

With reference to Figure 2 the site would be downwind of the nearby industry for approximately 47% of the time.

With reference to Figure 4 the average wind speeds for the sectors of interest are: SW - 6.9 km/hr, W – 9.2 km/hr, NW – 9.4 km/hr, N – 15.0 km/hr.

Figure 5 shows the average wind speeds for the sectors of interest for each of the monitoring periods.

A number of interesting features may be noted from Figure 5. The northerly winds tend to be quite strong for most of the year (in excess of 13 km/hr), while during late autumn and early winter they are only around 8-9 km/hr. The average wind speeds for southwesterly winds tend to be highest during the winter and summer months. Westerly winds tend have their lowest speeds during the cooler months of the year, whereas northwesterly winds tend to be strongest during the winter months.

Figures 6-9 show respectively for SW, W, NW and N winds the frequency of occurrence for each monitoring period, along with the wind speed distribution.

Figure 6 indicates that there is a large seasonal variation in the frequency of SW winds, being significantly more frequent during the cooler months than during the summer months. Generally SW winds tend to be light.

Figure 7 indicates that W winds also occur more frequently during the winter months.

Figure 8 indicates that NW winds, occurred more frequently during spring. The frequency of light winds (1-5 km/hr) is generally quite low.

Figure 9 indicates that there is a large seasonal variation in the frequency of N winds, being significantly more frequent during the summer months than during the winter months. Generally N winds tend to be moderate to strong.

7 Dust Monitoring Results

All of the dust samples were successfully retrieved and taken to the laboratories of Sigma energy Solutions, where they were analysed. The comprehensive technical reports prepared by Sigma Energy Solutions have previously been attached to the quarterly reports. These contain all of the analyses carried out on the samples.

The results reported for each sample collected and analysed are the following:

(i) insoluble matter (mg/m^2/day);

(ii) ash (mg/m^2/day);

(iii) percentage ash;

(iv) cement in insoluble matter; and

(v) cement in percentage in ash.

In addition the samples were inspected and analysed with respect to the following materials, representing the products handled nearby and identified in Section 3 of this report:

(i) mineral depositions;

(ii) coal particles; and

(iii) wood particles.

These materials have been analysed in terms of "projected area basis". As explained previously this term means the approximate percentage of the area a type of material covers and does not represent the percentage weight or volume, since the specific gravity of the various materials is not known.

To enable a comparison on a sample by sample basis the insoluble matter (in terms of mg/m^2/day) for the sample was multiplied by the percentage the relevant constituent (ie mineral depositions, coal, wood particles) occupied on a projected area basis (PAB). The units are in terms of mg/m^2/day-PAB. It should be understood that this is not a standard unit and that it cannot be measured, but rather allows for a relative comparison between samples.

A number of figures have been produced which show the results obtained for each

Figure 10 shows the deposition rates for insoluble matter as a function of monitoring period.

Figure 11 shows the mineral deposition-PAB as a function of monitoring period.

Figure 12 shows the deposition rates for cement as a function of monitoring period.

Figure 13 shows the coal deposition-PAB as a function of monitoring period.

Figure 14 shows the wood deposition-PAB as a function of monitoring period.

Each of these figures also shows the annual averages.

8 Discussion

8.1 Insoluble Matter

From Figure 10 it is evident that the deposition rates obtained at location 2 were on 6 occasions well above the generally accepted limit of 120 mg/m^2/day for residential locations. Two exceedances occurred at location 1 and one exceedance at each of locations 3 and 4.

Figure 11 shows the mineral depositions in terms of mg/m^2/day-PAB. A comparison of this figure with Figure 10 shows that most of the insoluble matter is due to mineral depositions. These are mainly due to earthworks which occurred from time to time during the monitoring period.

8.2 Cement

For monitoring locations to be downwind of the cement plant the following wind directions are required: locations 1 and 4: SW winds; location 2: W winds, and location 3: NW winds.

A comparison of Figure 12 and Figure 6 shows that the amount of cement deposited at locations 1 and 4 generally follows the frequency of SW winds.

A comparison of Figure 12 and Figure 7 shows that the amount of cement deposited at location 2 does not closely follow the frequency of W winds, although the concentrations during winter tend to be higher than those during summer, in keeping with the frequency of the winds.

A similar conclusion may be drawn for the amount of cement deposited at location 3 and the frequency of NW winds by comparing Figure 12 and Figure 8.

It is not surprising that better correlations do not occur, because the analysis assumes that the emissions do not vary with time.

Based on the above data it may be concluded that cement fallout occurs on the subject site due to the cement operations nearby, at an annual average of between 0.6 mg/m^2/day and 1.4 mg/m^2/day. During the winter months the cement fallout is as high as 3.6 mg/m^2/day.

8.3 Coal

For monitoring locations to be downwind of the coal facility the following wind directions are required: locations 1, 2 and 4: SW winds, and location 3: W winds.

A comparison of Figure 13 and Figure 6 shows that the amount of coal deposited at locations 1, 2 and 4 generally follows the frequency of SW winds, ie relatively high depositions during the winter months when SW winds occur more often than during the summer months. A similar conclusion may be drawn for location 3 by comparing Figure 13 and Figure 7.

Based on the above data it may be concluded that coal fallout occurs on the site due to the coal operations nearby.

From Figure 13 the highest coal fallout is at location 2, with an annual average of 5.7 mg/m^2/day-PAB throughout the year. This is more than twice that at location 1 (2.8 mg/m^2/day-PAB), the next highest result. At location 4 the annual average is 2.6 mg/m^2/day-PAB and at location 3, 1.7 mg/m^2/day-PAB.

It is worth noting that during the winter, on a monthly basis, the maximum fallouts are significantly higher than the annual fallouts (up to 13.5 mg/m^2/day-PAB) at location 2.

8.4 Wood

From Figure 14 it is evident that the highest fallout of wood particles is off the site at location 4, with an annual average of 13.7 mg/m^2/day-PAB. This location is nearest to the woodchip facility.

The fallout of wood on the subject site is significantly lower, ranging between 0.6 mg/m^2/day-PAB at location 3 to 2.3 mg/m^2/day-PAB at location 1.

8.5 Summary

Table 8.1 shows a summary of the fallout data obtained.

Table 8.1 Summary of monthly fallout data on subject site

Particulate	Location								
	1			2			3		
	min	average	max	min	average	max	min	average	max
Insoluble matter	38	96	344	13	338	1349	1	75	148
Mineral depositions	7	59	258	3	260	1214	<1	35	89
Cement	0.1	1.0	3.4	0.1	1.4	3.6	0.1	0.6	1.4
Coal	<0.1	2.8	8.6	<0.1	5.7	13.5	<0.1	1.7	4.4
Wood	<0.1	2.3	9.6	<0.1	0.9	8.5	<0.1	0.6	2.9

From Table 8.1 it may be noted that the highest fallout tend to be at location 2, except for wood, where the highest fallout occurs near location 1.

As expected the highest fallout on the subject site occurs along it western boundary, which is nearest to the port loading facilites.

9 Conclusion

The dust monitoring has indicated that the following particulates are deposited on the site: cement, coal and wood. (How significant are these?) From the meteorological data collected it appears evident that the nearby sources to the north west of the subject site contribute to these deposits.

In addition mineral depositions have been collected. These are most likely due to earthworks, generally located near location 2 (western boundary opposite the woodchip facility).

Generally these airborne particulates collected on the subject tend to decrease with increasing distance from the western boundary. The highest deposition rates were generally obtained at location 2, opposite the woodchip facility.

ASK Consulting Engineers Pty Ltd
Cnr Leichhardt Street & Wickham Tce
Spring Hill Qld 4000
PO Box 501 Spring Hill Qld 4004
P 07 38317511 F 07 38317661
www.askce.com mail@askce.com

Port of Brisbane Corporation
Figure 1
Subject Site & Monitoring Locations

Legend

● Locations 1, 2, 3 & 4
Dust deposition gauges

Figure 2. Overall view of annual meteorology

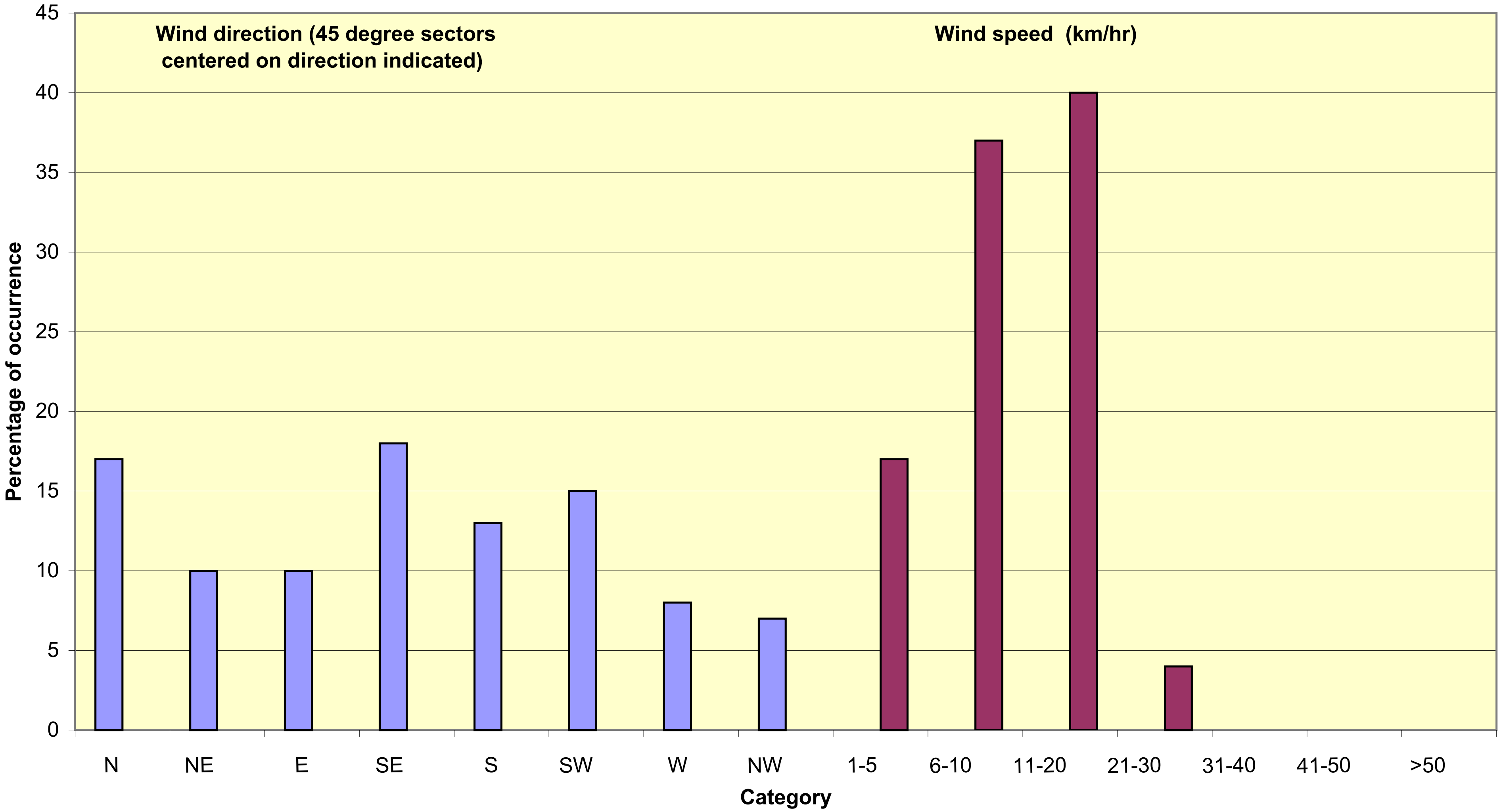

Figure 3. Wind speed occurrences within each sector

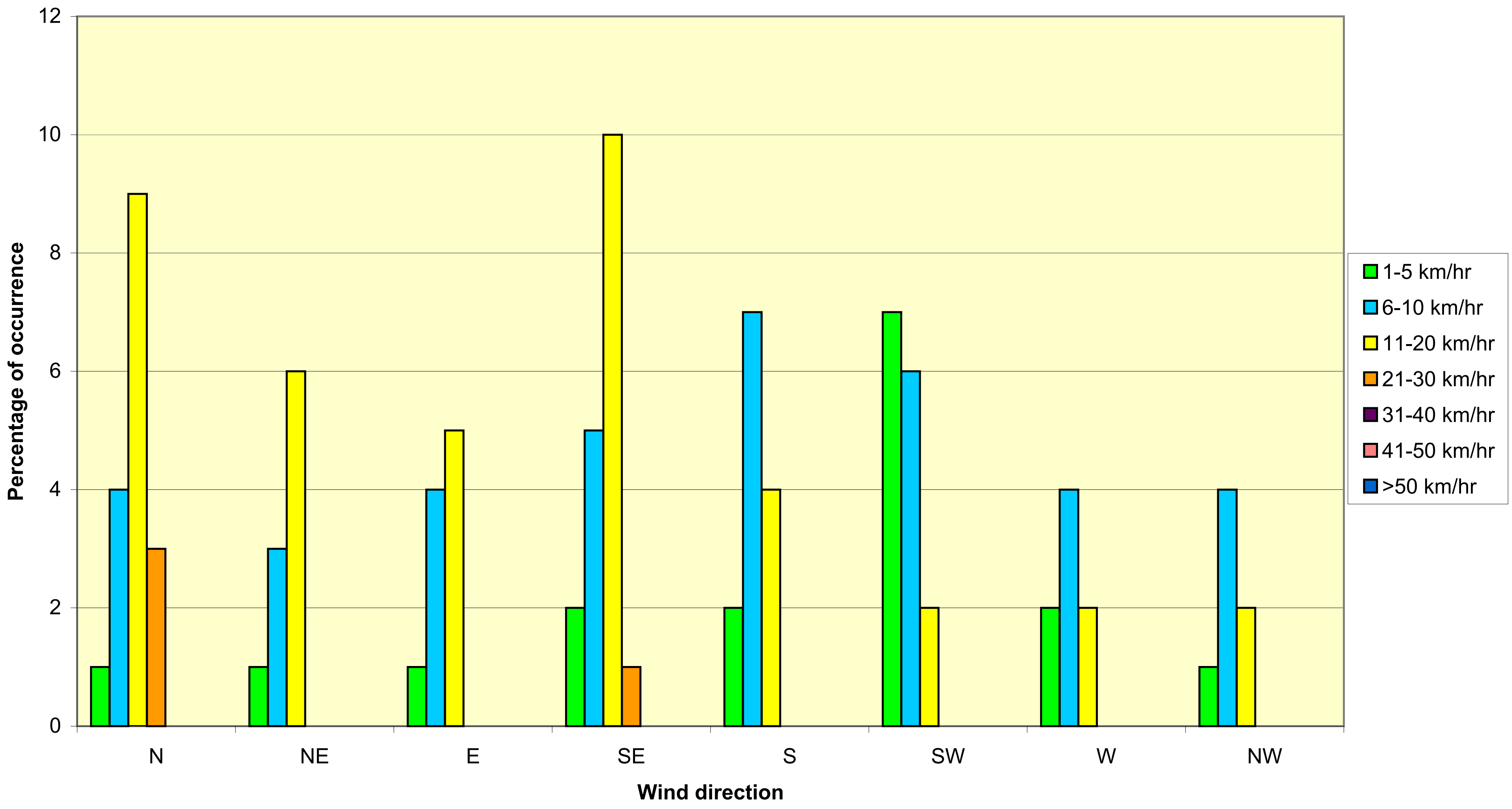

Figure 4. Average wind speed per sector

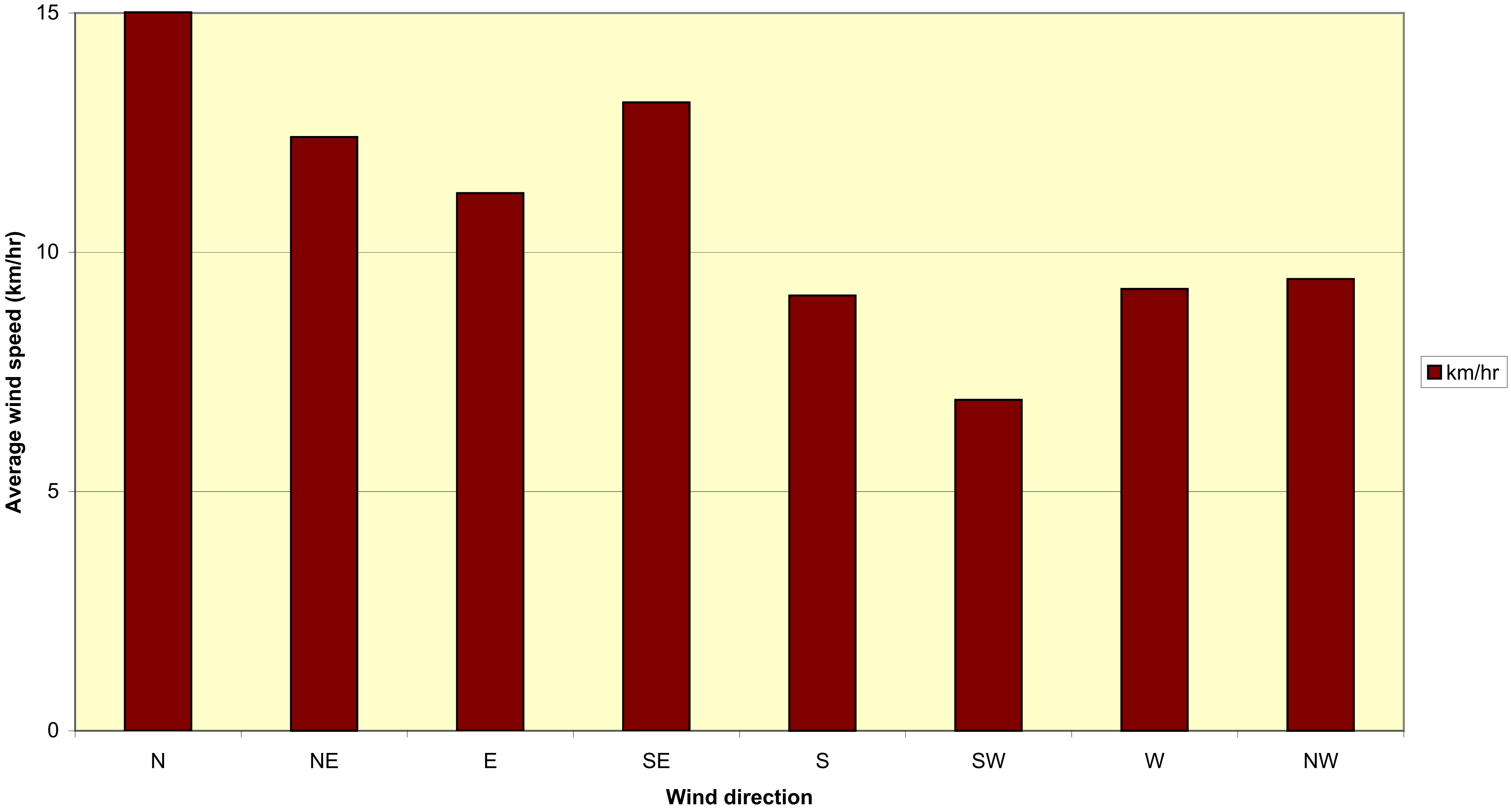

Figure 5. Average wind speeds for the wind directions of interest as a function of monitoring period

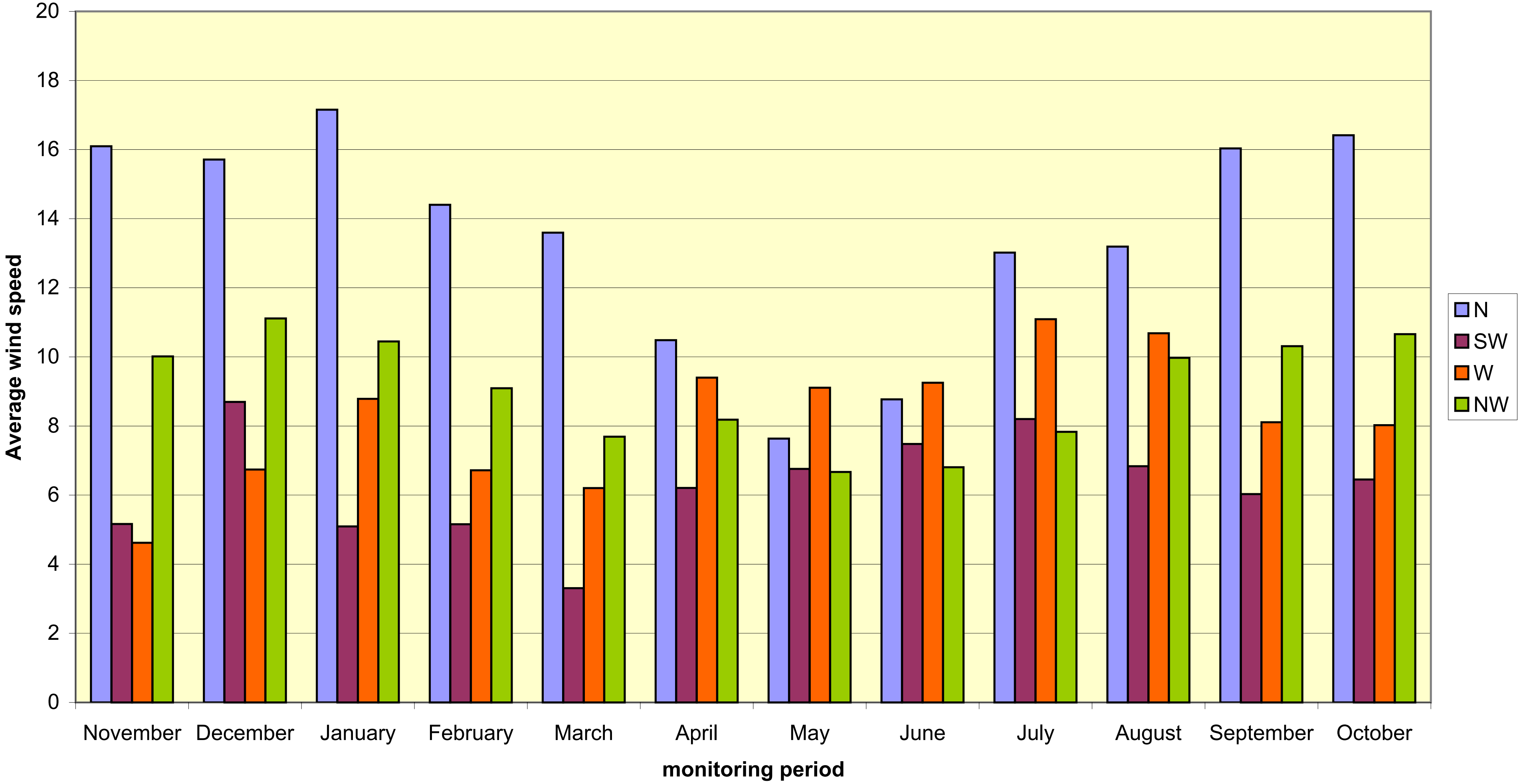

Figure 6. Frequency of occurrence of SW winds as a function of monitoring period

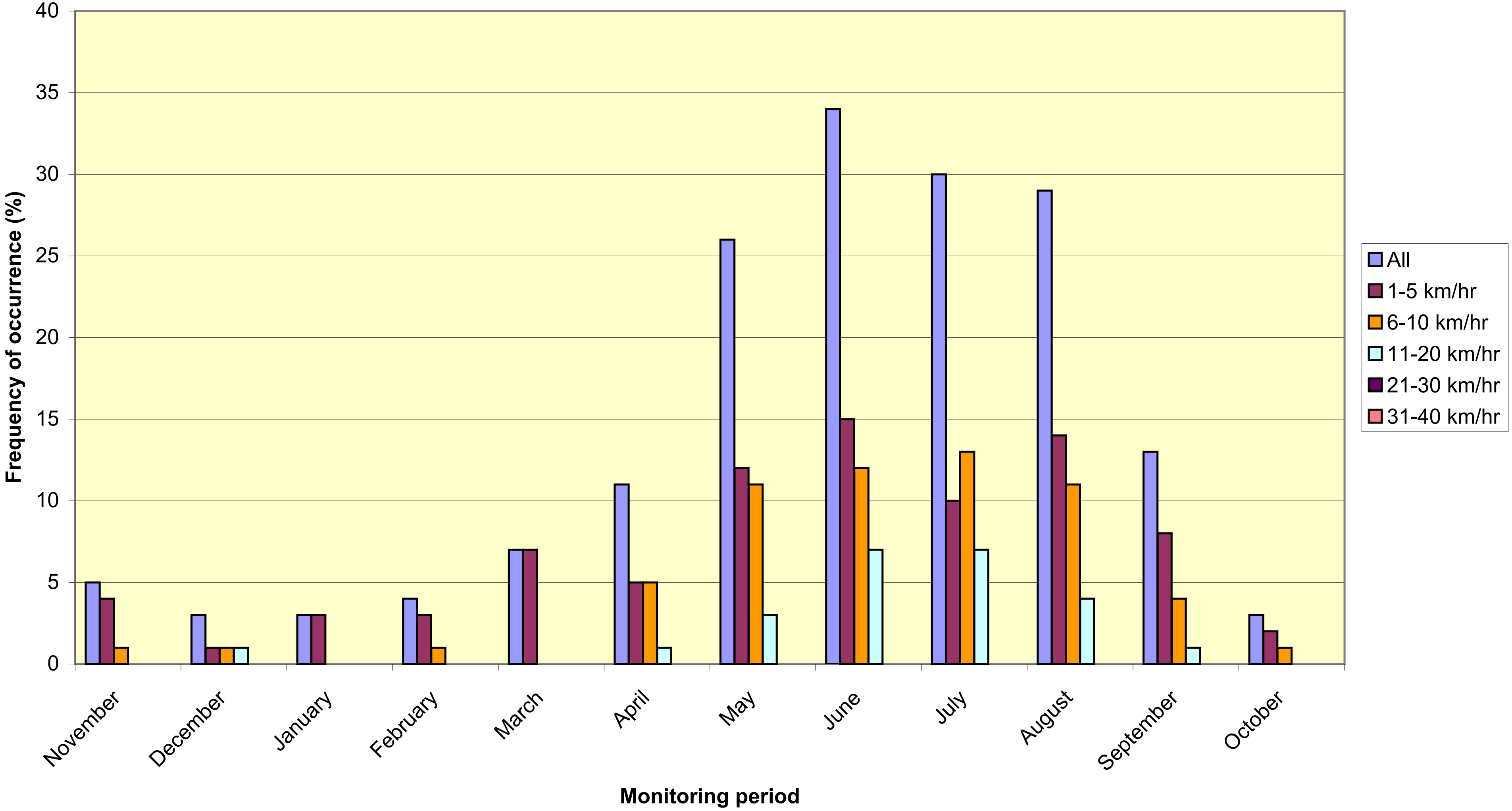

Figure 7. Frequency of occurrence of W winds as a function of monitoring period

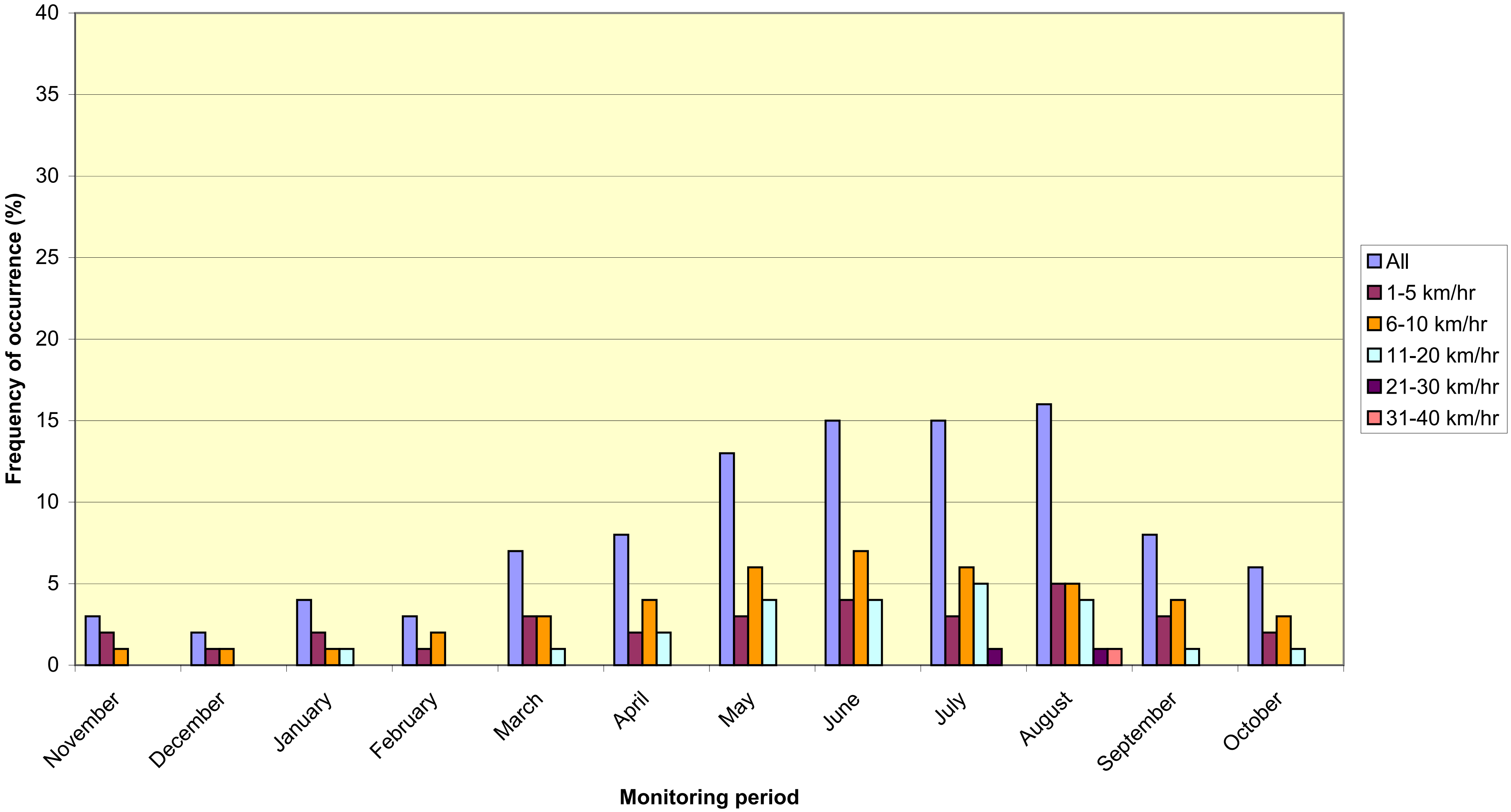

Figure 8. Frequency of occurrence of NW winds as a function of monitoring period

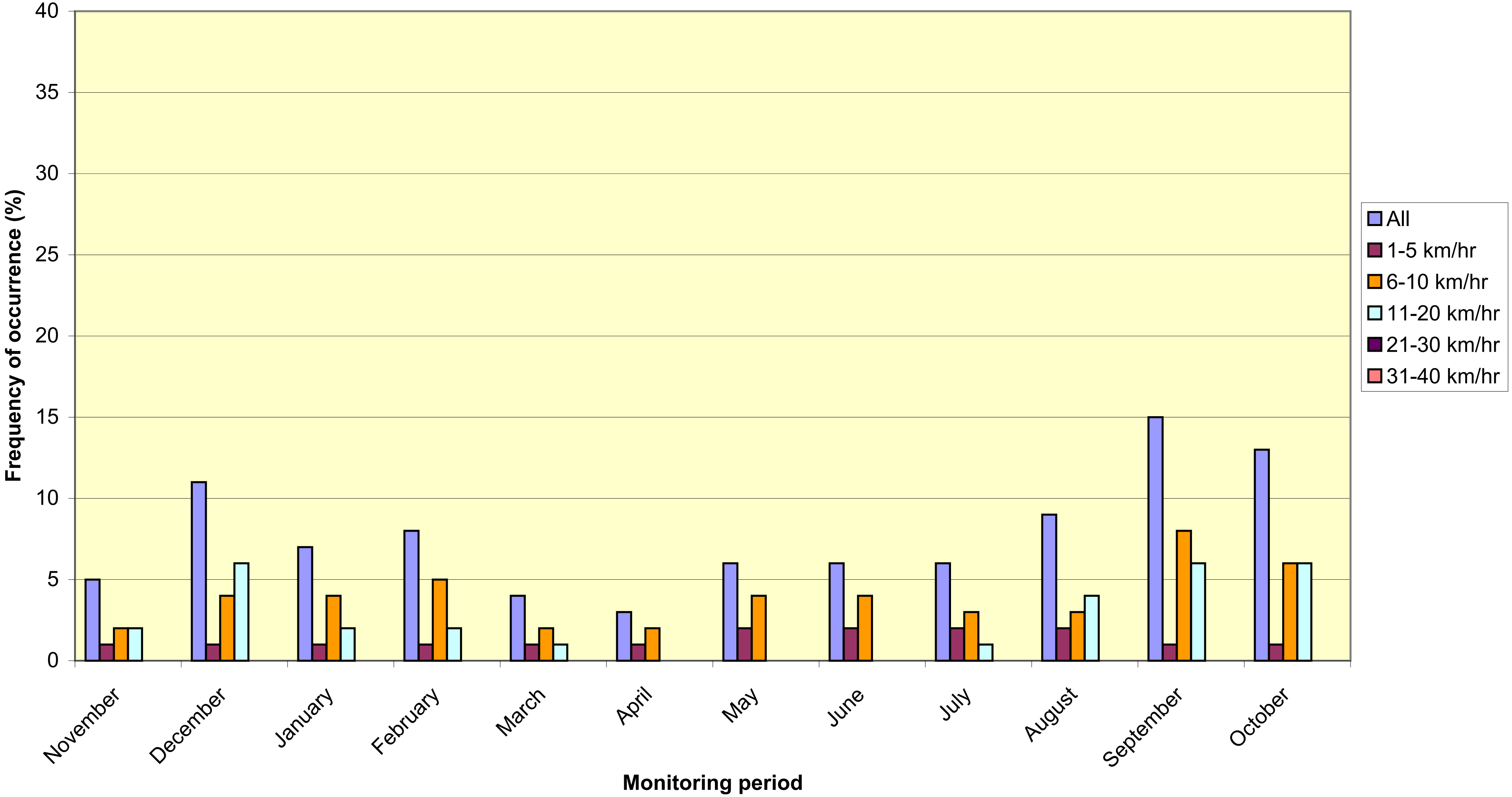

Figure 9. Frequency of occurrence of N winds as a function of monitoring period

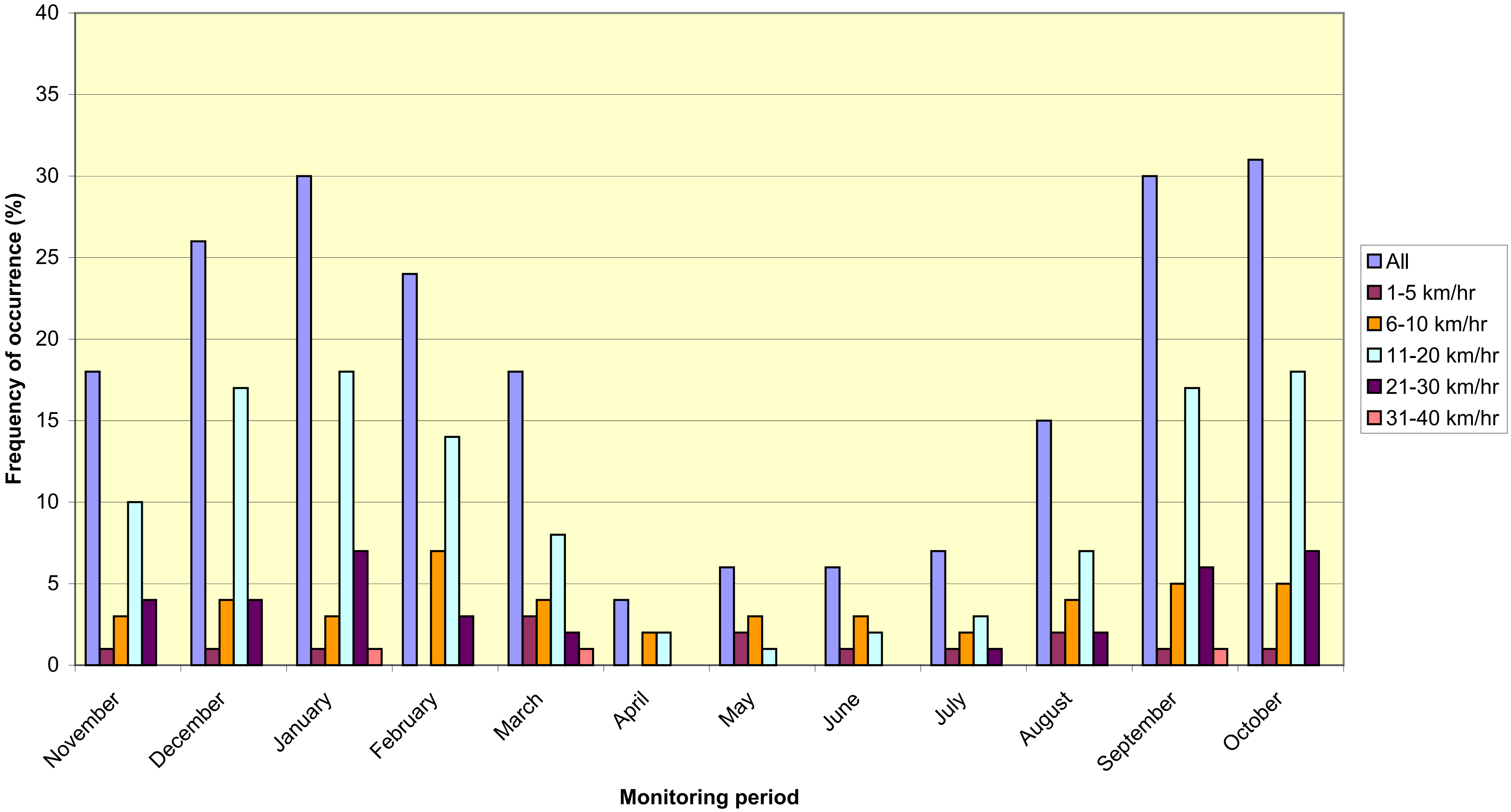

Figure 10. Insoluble matter contained in samples at locations 1-4

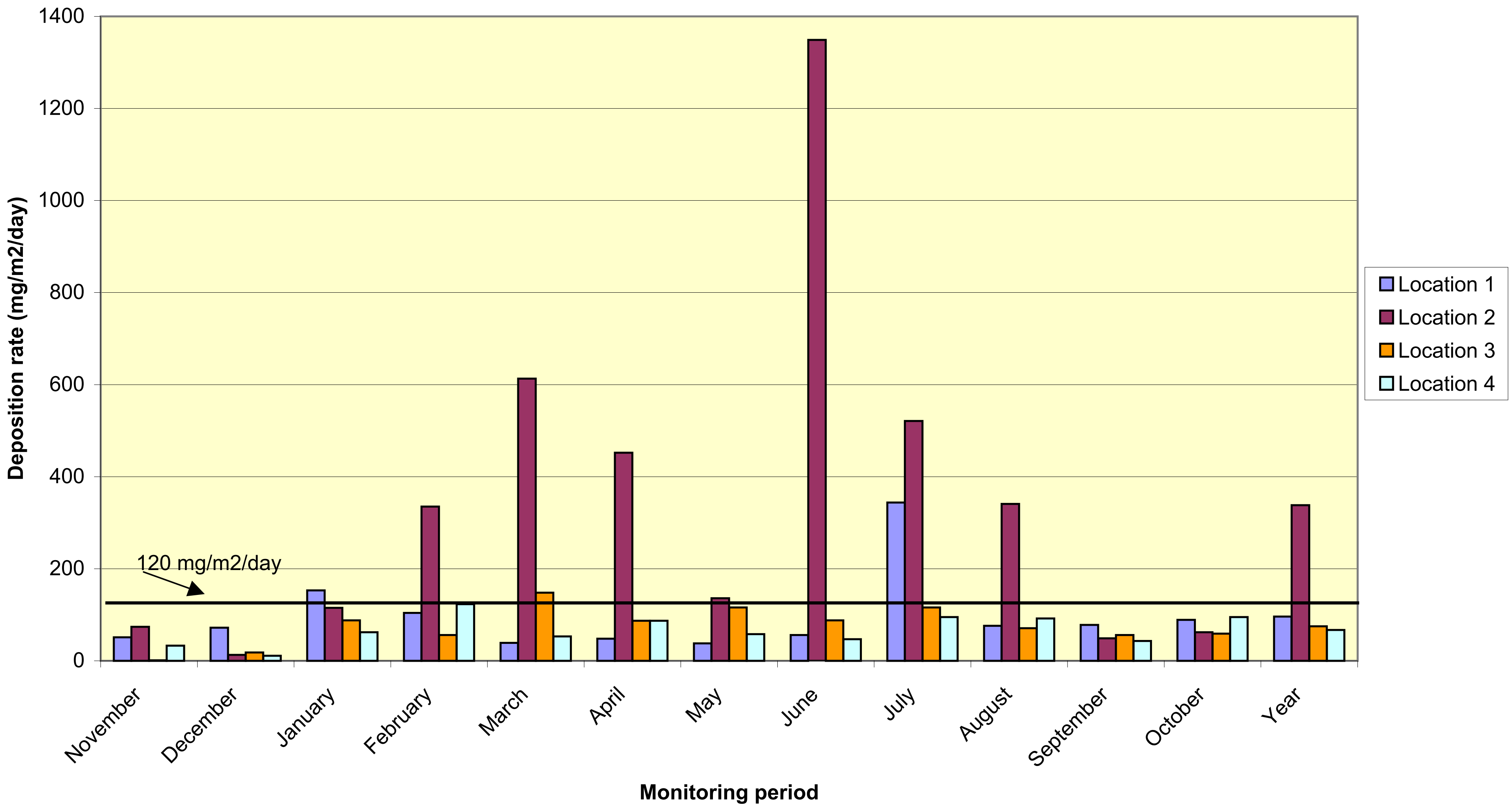

Figure 11. Comparison of mineral depositions at locations 1-4

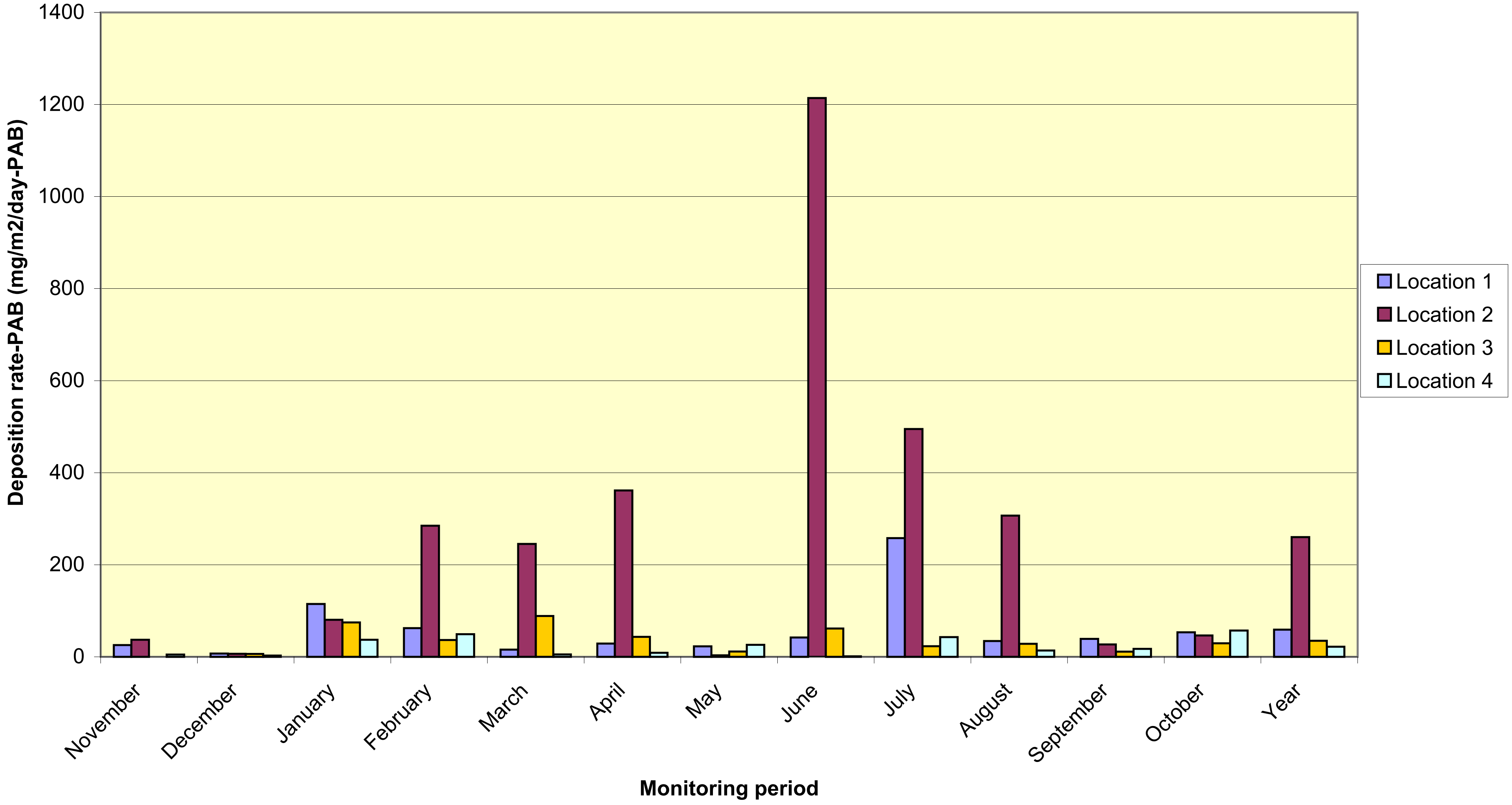

Figure 12. Cement contained in samples at locations 1-4

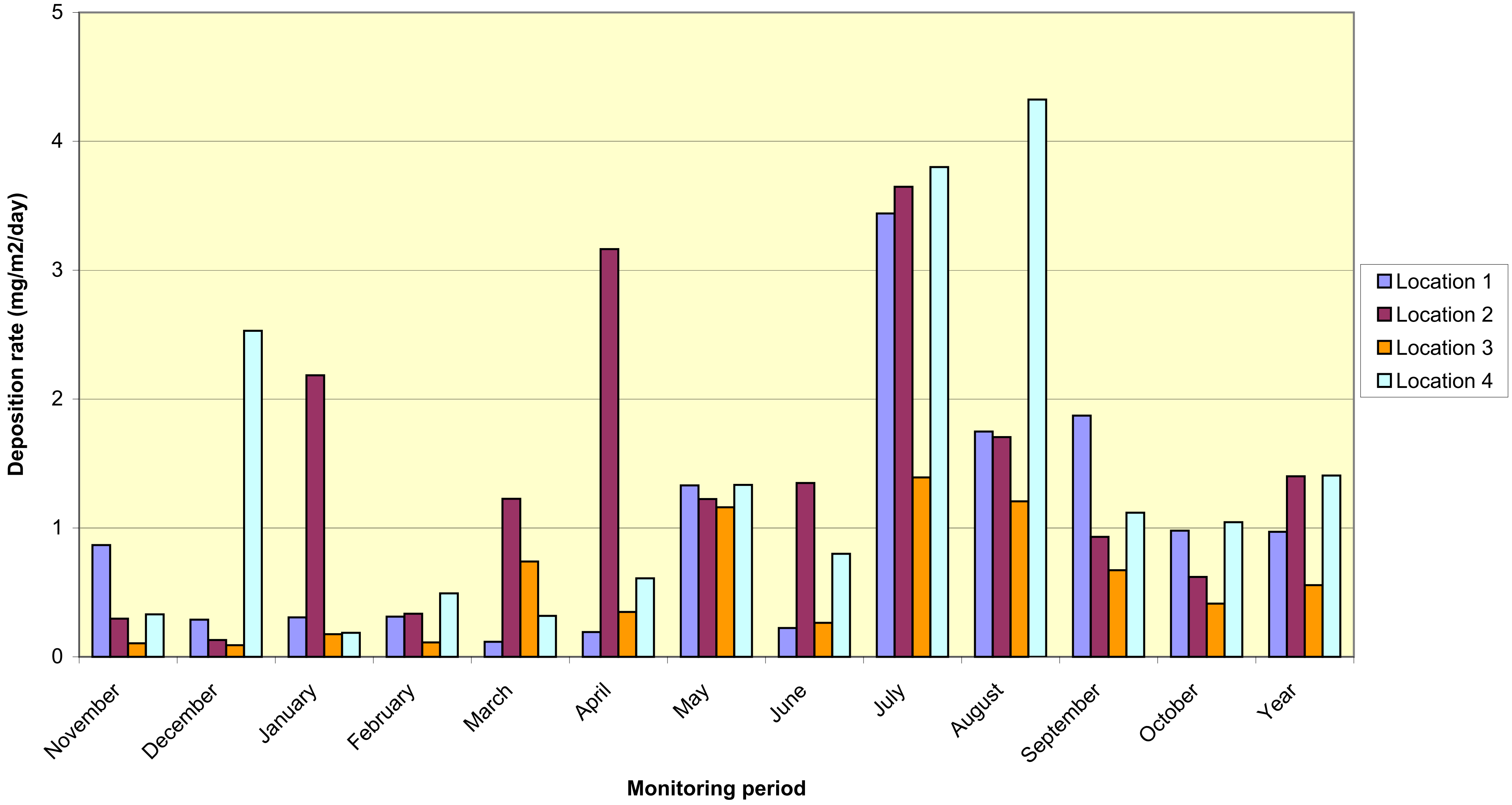

Figure 13. Comparison of coal depositions at locations 1-4

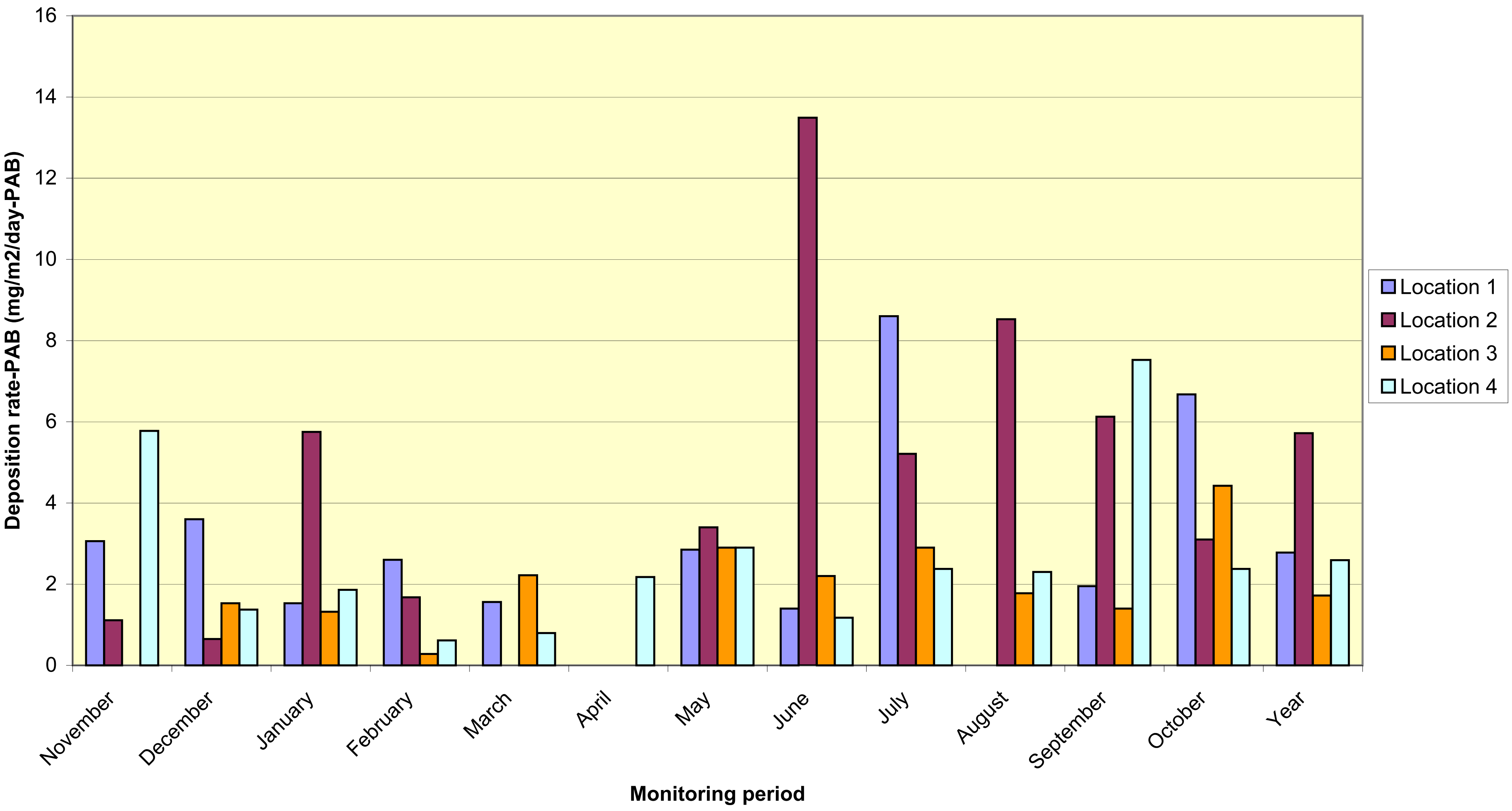

Figure 14. Comparison of wood depositions at locations 1-4